ARTIFICIAL INTELLIGENCE IN PRACTICE

HOW 50 SUCCESSFUL COMPANIES USED AI AND MACHINE LEARNING TO SOLVE PROBLEMS

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Introduction

One thing is very clear, artificial intelligence (AI) is going to change our world forever. And the change is likely to be more profound than most people realize today. No matter what job you are in, no matter what business or industry you work in, AI is going to augment, if not completely transform, it.

AI is giving machines the power to see, hear, taste, smell, touch, talk, walk, fly and learn. This in turn means businesses can develop completely new ways to interact with their customers, offer them much more intelligent products and service experiences, automate processes and boost business success.

Having said that, we also know there is a massive amount of hype and confusion about AI. Some see it as the ultimate threat to our civilization, while others believe AI is the savior that's going to solve humanity's biggest challenges, from tackling climate change to curing cancer. The aim of this book is to cut through the hype and scare-mongering, and provide a cutting-edge picture of how AI is actually being used by businesses today.

By sharing some of the latest and most innovative real world use cases from across many industries, we hope to demystify AI while at the same time inspiring you to see the immense opportunities AI is offering. We have written this book for anyone who would like to better understand AI and have therefore tried hard to keep the technical details to a level anyone can understand. At the same time, we have attempted to include just enough techie stuff to make it informative for people who already work in the field of AI.

In this book, you will of course gain insights into how some of the AI giants such as Google, Facebook, Alibaba, Baidu, Microsoft, Amazon and Tencent use it, but you will also learn how many traditional incumbent companies across most industries as well as innovative start-ups use AI. Our hope is that this will provide a realistic picture of the current state of the art: where the AI trailblazers are rolling full steam ahead, leaving many traditional businesses behind in the starting blocks; where traditional businesses are working hard at reinventing themselves and using AI to stay competitive; and where start-ups are using AI to challenge both the AI trailblazers and traditional businesses.

The Most Powerful Technology Of Mankind

AI is the most powerful technology available to mankind today and the biggest mistake anyone can make is to ignore it. Leaders of nations and businesses alike are seeing both the magnitude of opportunities AI brings and the risks of being left behind in the AI goldrush.

In the United States, the White House has released numerous policy documents that emphasize the strategic significance of AI. In 2016, under President Barack Obama, the White House issued the first report “Preparing for the Future of Artificial Intelligence”,[1] which laid the foundation for a US AI strategy. In 2018, under Donald Trump, following an AI summit at the White House, the administration issued “Artificial Intelligence for the American People”[2] in which President Trump states: “We're on the verge of new technological revolutions that could improve virtually every aspect of our lives, create vast new wealth for American workers and families, and open up bold, new frontiers in science, medicine, and communication.” The goal of the US Administration is to maintain American leadership in AI by accelerating AI research and deployment, and by training the future American workforce to take full advantage of the benefits of AI.[3]

Russia's President Putin said: “Artificial intelligence is the future, not only for Russia, but for all humankind. [...] Whoever becomes the leader in this sphere will become the ruler of the world.”[4] China has arguably developed the most ambitious plan to make use of AI with a goal of becoming the world leader in AI by 2030.[5] In Europe, the European Commission released its AI strategy in 2018, in which it states: “Like the steam engine or electricity in the past, AI is transforming our world, our society and our industry. Growth in computing power, availability of data and progress in algorithms have turned AI into one of the most strategic technologies of the 21st century. The stakes could not be higher. The way we approach AI will define the world we live in.”[6]

Business leaders agree. Amazon CEO Jeff Bezos believes we have entered the “golden age” of AI that allows us to solve problems that once were the realm of sci-fi.[7] Google co-founder Sergey Brin said: “The new spring in AI is the most significant development in computing in my lifetime”[8] and Microsoft CEO Satya Nadella calls AI the “defining technology of our times”.[9] The founder and executive chairman of the World Economic Forum, Klaus Schwab, together with many others, believes that AI (especially when combined with all other technological innovations) has triggered a fourth industrial revolution that is going to transform all parts of business and society.[10]

What's Artificial Intelligence? The Rise Of Deep Machine Learning

AI is nothing new and nothing magical. The first developments in AI date back to the 1950s. AI refers to the ability of computer systems or machines to display intelligent behavior that allows them to act and learn autonomously. In its most basic form, AI takes data, applies some calculation rules (or algorithms) to the data and then makes decisions or predicts outcomes.

For example, the data could be images of handwritten words, letters or numbers. The algorithm would be a computer program written by a human that contains rules such as the common shapes of each letter and spacing between words. This then allows a computer to analyze scanned images of handwritten text, apply the rules and make predictions about which letters, numbers and words it contains, enabling machines to recognize handwriting. This type of AI has been used, for example, by the US Postal Services to automatically read addresses on letters from as early as 1997. For narrow applications this kind of AI worked well.

This rule-based AI runs into difficulties when tasks are more complex or when we humans can't easily explain the rules and therefore can't program them into algorithms. Speaking our language, walking around and recognizing a friend in a crowd are all examples of skills that we have acquired through experience but for which we can't easily explain the rules.

We have learned those skills via a network of neurons in our brain that have been programmed to, for example, recognize a face by looking at the face from lots of different angles over a period of time, or we have learned how to walk and talk through trial and error. In modern AI, we basically replicate this process using artificial neural networks and instead of having humans programming the rules, we let the machines create the rules by themselves, similarly to how our brain learns from experience. We refer to this as machine learning.

In machine learning, we train AI with data by, for example, feeding it thousands of images that either contain human faces or don't contain human faces. The computer then takes in the information and creates its own algorithm either completely independently (unsupervised machine learning) or with help from humans (supervised or semi-supervised machine learning). When machine learning uses multiple layers of artificial neural networks to learn from training data (which makes them more powerful), we refer to it as deep learning.

Deep learning has given us many of the recent advances in AI, such as the ability for computers to see and recognize what or who is in an image or in a video (machine vision). Or it has given machines the ability to understand and reproduce written text or spoken words, which we call natural language processing and see in website chatbots or home smart speakers like Amazon's Echo.

There are two key reasons why deep learning is thriving today:

1. We have data: Data is the raw material that is fuelling AI and in today's big data world we are generating more data than ever before. The digitization of our world means that almost everything we do leaves a data trail and we are increasingly surrounded by smart devices that collect and transmit data. This is causing exponential growth in the volume and types of data we can now use to train AI.
2. We have computing power: We now have the ability to store and process vast amounts of data. Breakthroughs in cloud computing allow businesses to cheaply store almost unlimited volumes of data and use distributed computing to analyze big data in near real time. What's more, advances in chip technology mean AI computations can now be performed on devices such as smartphones or other smart connected devices. We refer to this as edge computing on Internet of Things devices.

We humans continuously learn and improve through experience. This “learning by doing” approach can now also be replicated by machine learning algorithms via reinforcement learning. Similarly to how toddlers learn to walk by adjusting actions based on the outcomes they experience, such as taking a smaller step if the previous broad step made them fall, AI uses reinforcement learning algorithms to determine the ideal behavior based upon feedback from the environment. Reinforcement learning gives machines (for example, robots) the ability to walk, drive or fly autonomously. Many leading-edge applications of machine learning combine deep and reinforcement learning techniques.

If you would like to learn more about any of these fascinating topics, head to www.bernardmarr.com where you can find hundreds of articles and videos explaining and discussing everything you need to know about AI and machine learning.

Artificial Intelligence Opportunities In Business

There are three key use cases for AI in business, which can overlap to some degree, but help to segment the opportunities. Businesses can use AI to: (1) change the way they understand and interact with customers, (2) offer more intelligent products and services, and (3) improve and automate business processes.

Customers: AI can help businesses better understand who their customers are, predict what products or services customers are likely to want, predict market trends and demands and provide more personalized interactions with customers. In this book, we will look at companies like Stitch Fix and Facebook, which use AI to really get to know their customers.

Products and services: AI can help businesses create more intelligent products and services to offer to their customers. Customers want more intelligent products such as smarter phones, smarter cars and smarter home devices. In this book, we will look at how Apple, Samsung and car companies such as Tesla and Volvo use AI to create smarter products and we explore how others like Spotify, Disney or Uber use AI to deliver more intelligent services to their customers.

Automate processes: AI can improve and help automate business processes. In this book, we will look at examples such as JD.com that is using autonomous drones, automated fulfilment centers and delivery robots to transform its retail operations. We will also look at how AI can automate medical diagnosis in the Infervision and Elsevier case studies, and even the pizza quality checks at Domino's.

The Strategic Use Of Artificial Intelligence In Business

Exploring the applications of AI in any business will often lead to a business model refresh or even a complete transformation of the business approach. It is important that companies don't use AI to automate and improve a business model that is no longer relevant during the fourth industrial revolution.

The starting point for any use of AI should be an AI and data strategy that identifies the biggest strategic opportunities and threats for any business and then pinpoints the most impactful applications. It is important to recognize that simply experimenting with AI around the edges is not going to deliver the necessary effects on business success.

Artificial Intelligence In Practice

In this book, you will find 50 company use cases and within them even more leading-edge examples of how these companies have used AI in practice to solve real world problems. We have divided the book into five parts.

Part 1 contains case studies from the AI trailblazers. These tech companies are the ones that have grabbed hold of the AI opportunities and are running with them to transform industries and deliver mouth-watering business results. Most of them have made innovative applications of AI part of all aspects of their business and therefore provide great insights into the art of the possible.

We could have segmented the remaining case studies in different ways, by AI application or by industry. Based on the feedback we received, we opted for the following industry segmentations.

In Part 2 we look at retail, consumer goods and food and beverage companies. In Part 3 we explore how media, entertainment and telecom companies use AI. Part 4 looks at the services sector, including financial services and healthcare. Finally, in Part 5 we look at manufacturing, automotive, aerospace and industry 4.0 case studies.

You can simply read this book cover to cover or dip in and out to explore the case studies or industries you are most interested in. We hope you will enjoy it!

Notes

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Part 1

Artificial Intelligence Trailblazers

1
Alibaba: Using Artificial Intelligence To Power The Retail And Business-To-Business Services Of The Future

Alibaba Group is a Chinese multinational conglomerate that operates the world's largest e-commerce network through its web portals, which include Alibaba.com, Taobao, Tmall and Ali Express. With global sales that dwarf those of Amazon and eBay combined,[1] the business took what it learned from building a global online retail platform and has applied it to enterprises in just about every area of business and technology. Alibaba's success in delivering e-commerce and retail services, electronic payment, as well as business-to-business cloud services, has earned it a market cap in excess of US$500 billion.

Its customers use artificial intelligence (AI) tools to help them find what they want when they shop at its online portals, and as one of the world's largest cloud computing providers it also licenses platforms, tools and cloud services to other businesses to help them leverage AI.

Beyond that, Alibaba is rolling out AI across the wider society, with projects involving turning entire cities into “smart cities”. They are also planning on revolutionizing China's (and perhaps the world's) agricultural industries to ease the burden of feeding a growing population.

How Does Alibaba Use Artificial Intelligence?

The Chinese government has strongly supported efforts by businesses to adopt AI, clearly believing that it has enormous potential for driving economic growth. Its goal is to foster a $1 trillion industry and be the world leader in AI by 2030.[2]

This, combined with the fact that the country's enormous population gives companies access to huge amounts of data on customers’ lives, makes the country a fertile ground for AI development.

Alibaba's e-commerce portals use sophisticated AI to choose which items to display to customers when they visit and search for products they want to buy. It does this by building a custom page view for every visitor, aimed at showing them items they will be interested in, at prices that seem right.

By monitoring customer actions – whether they make a purchase, browse to a different item or leave the site – it learns in real time to make adjustments to these page views to increase the probability of the visit ending in a purchase.

To train its e-commerce portals to show visitors pages that are likely to result

service.

In 2017 it announced it would invest $15 billion over the next three years, expanding its global network of AI research and development facilities.

It calls this program the Academy for Discovery, Adventure, Momentum and Outlook – DAMO – and will involve recruiting 100 researchers for its labs in Beijing and Hangzhou, China, and San Mateo and Bellevue in the United States, as well as others in Moscow, Tel Aviv and Singapore.[11]

Research at the labs will focus on machine learning, natural language processing, Internet of Things, human/machine interaction and quantum computing.

Key Challenges, Learning Points And Takeaways

- Alibaba is China's biggest investor in research and development, which has given it a strong start in the race to become the world leader in AI.
- Its model for rolling out AI to millions of customers and businesses is to deploy its services through the cloud. This cuts customer risk and infrastructure cost, while giving Alibaba access to valuable data about how its customers behave.
- By applying technology designed to drive sales at its retail portals to other problems in business and society, it identifies new use cases for AI, within and outside its established business operations.

Notes

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2
Alphabet and Google: Maximizing The Potential Of Artificial Intelligence

Alphabet is a US-based multinational internet services, technology and life-sciences conglomerate. Its businesses include internet-search giant Google, life-sciences company Verily, self-driving technology company Waymo, smart home device company Nest, artificial intelligence (AI) company Deep Mind, among others.

In his founder's letter in 2017, Sergey Brin, the president of Alphabet, wrote: “The new spring in artificial intelligence is the most significant development in computing in my lifetime.”[1] Given that this includes the arrival of the internet, it's no small statement.

Alphabet understands the potential of AI and is set to use it across its businesses, from improving internet searches, to self-driving cars, automated homes, intelligent virtual assistants, language translation and life-saving medical science.

How Does Alphabet Use Artificial Intelligence?

Smarter Searching

Google's search engine – the most widely used in the world – is peppered with AI. Whether you use its text, voice or image search capabilities, every query is now (since at least the introduction of its Rankbrain feature in 2015) processed by smart, self-teaching systems.[2]

Text and voice search both employ natural language processing, so the algorithms attempt to understand how each word you enter as part of a search query relates to every other word it is used with, rather than just what each word means individually. This is semantic analysis, the key to natural language processing.

Google Image search uses computer vision to recognize the content of image data cataloged by Google, and classifies it so users can search for it using text or voice. Deep learning algorithms allow it to become increasingly good at recognizing and labelling different elements contained in pictures. The greater the variety of images it is exposed to, the better it becomes at knowing what they are.

Once Google's AI has processed your query and decided what it thinks you really want, it matches it against its directory of online content – web pages, images, videos and documents. These have also been processed by machine learning systems.

The systems are trained to sort, rank and filter all of the content in its

directory. Content is assessed for how frequently cited (linked) it is, the accuracy of information it contains, the possibility that the information might be spam or advertising, and whether it is likely to be illegal or copyright infringing.

This means a simple Google search involves a great deal of complex, blisteringly fast AI calculations. Building systems capable of processing billions of calculations every day from all around the world is what has made Alphabet and Google a genuine giant in the field of AI (as well as one of the richest companies in the world).

Google uses AI for many of its other core applications, including security measures, which keep Gmail accounts secure, and adwords, which allow businesses to pay for their ads to appear in searches of customers who may be interested.

Artificial Intelligence Personal Assistants

AI personal assistants using voice technology have been around for a few years now and Google Home, Amazon Alexa and Apple Siri are familiar to most of us.

Although these first implementations of natural language processing into consumer devices seem impressive compared to what was possible just a few years ago, anyone who has used one will know they have limitations. They can respond well to basic, relatively short sentences and commands, but try talking to them like you would an actual human and things start to unravel.

This is because, in human terms, they are still very much infants. Put simply, they haven't had enough data yet. This is quickly changing, and Google's Duplex tech is leading the charge.

Duplex is able to hold far more natural, less jilted conversations. This is because it is specifically trained for particular situations, and its algorithms exclusively specialize in gathering data that is relevant to those situations. An example used by Google to showcase its ability features Duplex making a call to book an appointment at a hair salon on behalf of its user.[3] In these relatively controlled and constrained use cases, it comes very close to appearing perfectly human.

One trick used by Google's engineers to get the machine to sound more human was to incorporate imprecise elements of our speech patterns. For example, it will utter an “umm”, an “aah” or an “mh-hmm” in places where it might seem natural for a human to do so.

Language Translation

Thanks to machine learning, if you can teach a computer to speak one language, it can teach itself to speak any language. That's the principle behind Google's language translation service, which uses deep learning to break languages down to their fundamental building blocks.

Google Translate uses deep neural networks to constantly refine its

algorithms as its users expose it to more languages. This means it becomes increasingly efficient at accurate translations. Google has even built the feature into its Google Assistant-powered Pixel Bud headphones, meaning users can get near real-time translations directly through their headsets.[4]

Self-Driving Cars

Alphabet's autonomous vehicle division, Waymo, has one of the most mature self-driving car platforms in the world, having recently become the first to make rides available commercially.[5]

Alphabet has gone down the road of developing its own vehicles, which are so automated they don't even include steering wheels or any driver controls. Designed for a new age of urban motoring where car ownership is often expensive and inconvenient, Waymo's service is aimed at the ride-sharing networks, which it predicts will make up transport networks in smart cities of the near future.

Captioning Millions Of Videos

Google also uses machine learning natural language algorithms to automatically create subtitles for the hard of hearing (or those who value peace and quiet) for videos on its YouTube video-streaming service.

As well as speech, the system uses deep neural networks to identify ambient sounds, including applause, music and laughter and automatically displays text telling the viewer what sounds are occurring.[6]

Diagnosing Disease

Alphabet's AI (specifically deep learning) technology has also been extensively deployed in the medical field. One recent breakthrough involves diagnosing eye conditions. For this, it applies learning algorithms to 3D infrared scans of eyeballs known as optical coherence tomography scans.[7]

The system relies on two deep learning algorithms, one of which builds up a detailed map of the eye's structure and learns about what is normal and what could be indicative of a problem such as age-related macular degeneration. The other makes diagnoses based on medical data and provides medical professionals with assistance in diagnosing and treating the illness.

Google Brain

Google's AI research division is known as Google Brain. It was formed by Google's Jeff Dean and Greg Corrado along with Andrew Ng of Stanford University in 2011, and their work has established them as pioneers of the current wave of practical AI technology.

Google Brain realized that the vast, super-fast storage networks it had built up, as well as the huge amount of data flowing through the internet (and

3
Amazon: Using Deep Learning To Drive Business Performance

Jeff Bezos founded Amazon as an online book store, but in reality he could have sold anything. His main focus was establishing a technology company that could dominate during the predicted boom in online retail, which he saw coming. Today, Amazon is a multinational e-commerce giant and the world's leading cloud computing provider, making it the third most valuable public company in the United States. Beyond its core retail and cloud business, the company also has a publishing business, a film and television studio operation, and produces consumer products such as the Kindle e-readers, Fire tablets and TV sticks, as well as the Amazon Echo.

Amazon has used predictive analytics since those earliest days in the 1990s. It has experience deploying these systems across its entire business – from its famous recommendation engines to optimizing the routes of robots working in its order fulfilment centers.

However, the growing power of machine learning has caused the online retail giant to reassess every aspect of its operations since the start of the current decade. Not content with merely competing with Walmart and Target for the retail market, it has always positioned itself as a rival to Google, Facebook and Apple, seeking leadership in the tech sphere.

This meant implementing deep learning technology into its core services, as well as expanding into new areas such as home automation with its Alexa-powered Echo devices and cashier-free retail stores.

Looking ahead, Amazon has grand plans involving automated delivery drones and “anticipatory shipping”, which will attempt to read your mind and ship products to you before you even order them!

How Does Amazon Use Artificial Intelligence?

Amazon pioneered the recommendation engine – search engines designed to sell us things – which has been the core of its business strategy since the beginning. Over the years, the analytics behind the scenes have become more sophisticated but it has always worked by segmenting customers according to the data it collects about them, modelling their behavior and matching them with items popular with others who fit a similar pattern.

In early 2014, the company began the single biggest overhaul of its recommendation system to date, when it started to implement deep learning algorithms into its prediction tools.[1] Deep learning is now built into many of the site's features, which are designed to present the user with a more personalized shopping experience, such as its “frequently bought together” and “customers who bought this also bought ...” recommendations.

Deep learning uses deeply layered neural networks that mimic human brains in the way they "learn" from the data that passes through them. These algorithms are capable of adapting themselves to become increasingly efficient at spotting patterns and relationships in data, in this case Amazon's transactional and customer behavioral data. They now power Amazon's recommendation engine just as they do Google's searches, Facebook's feeds and Netflix's movie suggestions. Like its rivals for the tech crown, Amazon is confidently backing deep learning as the technology that will power the artificial intelligence (AI) revolution.

Another key use case at Amazon is found in its fulfilment centers – warehouses where the millions of customer orders placed every day are picked and packed by humans working alongside sophisticated, AI-powered robots. When observed as a static, stand-alone piece of machinery, Amazon's warehouse robots may not look like much – simply squat, mobile platforms.[2] But driven by deep learning algorithms, they are able to efficiently route their way around labyrinthine stacks of portable shelves, locate whatever items are required and move them to the human picker who completes the assembly of each order. As robots can operate in far tighter conditions than humans, this initiative helps Amazon maximize the space available for stock in its warehouses, increasing revenue as orders can be filled more quickly. One hundred thousand of these robots are currently deployed in Amazon fulfilment centers around the world.[3]

Amazon Alexa

It's strange to think that the AI-powered personal home assistant device almost seemed like a novelty when Amazon first introduced it in 2015. As of 2018 they are a feature in 16% of US homes, and that figure looks set to increase as Amazon, along with Google, continue to improve, refine and market their devices.[4]

Amazon's breakthrough was to realize that the biggest factor limiting uptake of AI in the home wasn't the technology itself, which had matured to the point where it is more than capable of assisting with basic domestic tasks. It was the interface itself – while smartphones have become increasingly useful, they often still aren't as simple to use as, say, a light switch, kettle, radio or recipe book.

Echo made it straightforward for us to communicate using our voices with smart home devices, as well as a handy portal for quick information, or playing background music while we go about household chores.

The accuracy with which it can interpret our voice commands is due to Amazon's implementation of deep learning within its natural language algorithms.[5] Neural networks are used to detect the user's "wake word", which tells the device to start listening for and interpreting a command. As it processes voice commands it becomes increasingly efficient at understanding the nuanced ways human beings use spoken language. Effectively, the deep neural network "learns" about how we talk from the